ATTACHMENT # 1
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Killearn Lakes Units 1 & 2 Municipal Sewer Study

Summary Report

Prepared for

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EXECUTIVE SUMMARY

Due to the unsuitable conditions in Killearn Lakes Units 1 & 2 for the proper function of Septic Tank On-Site Treatment and Disposal Systems (OSTDS), there have been several single and multiple septic system failures throughout the development. As a result, Leon County imposed a moratorium in July 2004 that prohibits new development for a period of two years.

In response to this situation, Leon County retained PBS&J to evaluate alternative sewer technologies for constructing a municipal grade central sewer system. As part of this evaluation, PBS&J looked at several alternative sewer technologies; evaluating each in their performance and operational history, reliability, capital cost, O&M cost, impacts to neighborhoods, and other considerations in order to present viable solution alternatives to Leon County. Among the technologies, three proved most practical for this application - gravity, vacuum and low-pressure sewers systems, or a combination thereof.

It is commonly accepted that gravity sewers are the ideal, or preferred, technology because of their reliability, ease of operation, and limited required maintenance. Gravity systems have no mechanical equipment located at the service connections to the properties, and therefore require little maintenance throughout the collection system. Gravity systems generally require at least one central pumping station for each collection system basin. This central pumping station is a portion of the gravity system that requires the most maintenance; it requires power to operate; and can be readily equipped with an emergency generator to function during power outages. Because gravity sewers serving residential neighborhoods typically flow at a low velocity (about 2 feet per second), they will generally produce low levels of gasses and odors; but will not generally emit such odors throughout the community. Odors are generally isolated to pumping stations, at which control measures can be installed.

While construction of a gravity system in Killearn Lakes Units 1 & 2 is possible, it comes with some significant consequences. Of the three alternatives evaluated, gravity systems have the highest capital cost. A gravity system also has the greatest amount of disruption to the residents, the green spaces behind the properties, and the existing utility infrastructure (electric, water, gas, phone, cable, etc.). Finally, gravity sewers would take the longest time to construct of the three alternatives. As such, vacuum and low-pressure systems become attractive options and should be given due consideration.

Vacuum systems are also very reliable; and while the cost of a vacuum alternative for this project is considerably less than that of the gravity system alternative, it is greater than the low-pressure sewer system alternative. Vacuum systems rely on mechanical valves located at each point of connection to the property. Like the gravity sewer system, the vacuum system also requires a central (vacuum) station for each collection system basin. And while they also require power to operate, they also can be readily equipped with emergency generators to function during power outages. Unlike the gravity and low-pressure systems, vacuum systems move sewage at a very high velocity, aerating and mixing the sewage as it travels through the sealed piping network. As a result, fewer gases are produced, which results in less odors and maintenance effort. Construction of a vacuum system also causes a significant amount of disruption to the residents, the green spaces behind the properties, and the existing utility infrastructure (electric, water, gas, phone, cable, etc.); and they offer only a slight advantage in design and construction time over the gravity system.

The low-pressure system provides the most affordable total project cost among the alternatives and has the quickest time to complete design and construction. The systems are proven reliable but have some important disadvantages to consider. The first concern is that there will be over 1,300 mechanical pumps and electric panels that will require regular maintenance and replacement. The second concern is that there is the possibility that all 1,300-plus pump stations will not operate during a power outage. While power outages are not a common problem, the recent hurricanes in 2004 left several Florida communities without power for several days, and some for several weeks. This crippled several low-pressure sewer systems throughout the state. Another important consideration is the age, or "residence time," of the sewage as it travels through the collection system.

The velocities in a low-pressure piping system are typically low. In a large low-pressure network such as this, the sewage can remain in the pipe for several hours or even days before it reaches its final destination. This can produce potentially corrosive and odiferous gasses that can become a nuisance and potentially dangerous to the residents and the maintenance personnel - an issue that needs to be addressed during the design in order to minimize the effects.

A summary of the estimated construct costs and annual operation and maintenance cost is included in the table below:

Alternative Sewer Technology	Total Collection System Cost (Public R-O-W)	Total Service Connection Cost (Private Property)	Total Construction Cost	Annual Operation & Maintenance Cost
Gravity	$21,500,000	$6,800,000	$28,300,000	$33,000
Vacuum	$13,600,000	$6,800,000	$20,400,000	$103,500
Low-Pressure	$4,800,000	$11,700,000	$16,500,000	$106,000

Based on the evaluation criteria and information presented in this report, including the estimated total cost of construction and operation and maintenance, it is not recommended that a vacuum system be considered as a viable solution for this project. As such, the following conclusions are made to assist the County with selecting a sewer system alternative that serves the needs of the residents of Killearn Lakes Units 1 & 2.

- If time and capital cost were not factors in the decision, the gravity sewer system is the most reliable solution and offers the lowest O&M effort and cost.
- To save substantial time and cost, the low-pressure system is the also a reliable solution, but does have some drawbacks in long-term operation and maintenance of the grinder pump stations.

SECTION 1
INTRODUCTION

1.1 Purpose and Scope

The purpose of this study is to evaluate alternative municipal sewer technologies in order to present to Leon County a cost effective and reliable central sewer system to replace the failing septic tanks in Killearn Lakes Units 1 & 2. Specifically, this study will evaluate gravity sewer, low-pressure sewer, and vacuum sewer collection systems, or a combination thereof, and determine which system is best suited to serve Units 1 & 2. The evaluation will include a detailed discussion of the following items:

- Description of alternative systems
- System performance and reliability
- System operation and maintenance
- Conceptual design for alternatives
- Alternative methods of construction
- Engineer's estimate of probable costs including annual construction and operation and maintenance costs, and
- Utility Service Provider considerations

Upon consideration of the items listed above, the following report will serve as the basis for selection of a municipal sewer system for the County and, ultimately, the property owners with Killearn Lakes Units 1 & 2.

SECTION 2
DESIGN CRITERIA

2.1 Population and Design Flows

Killearn Lakes Units 1 and 2 was originally platted with 1384 total lots, of which 755 are in Unit 1 and 629 are in Unit 2. As a result of consolidating multiple lots during development, there are currently 1365 total lots in the two subdivisions, of which 739 are in Unit 1 and 626 are in Unit 2. Additionally, there are currently 199 lots that are undeveloped and not under construction (as of October 15, 2004), of which 179 are in Unit 1 and 20 are in Unit 2. Table 2-1 below summarizes the subdivision plat data.

Table 2-1
Killearn Lakes Plantation
Subdivision Plat Summary

Killearn Lakes Subdivision	Platted (1971)	Current (October 2004)		
	Total	Total	Developed	Undeveloped
Unit 1	755	739	560	179
Unit 2	629	626	606	20
TOTALS	**1384**	**1365**	**1166**	**199**

One possible reason for the drastic difference in undeveloped lots between the two areas is because Unit 1 has experienced far more septic tank failures (single and multiple occurrences) than Unit 2, which has likely contributed to slower development in that area. Table 2-2 below illustrates the distribution of recorded septic tank failures between the two units.

Table 2-2
Killearn Lakes Plantation
Recorded Septic Tank Failure Summary

Killearn Lakes Subdivision	Current (as of October 2004)		
	Single Failures	Multiple Failures	Total Failures
Unit 1	112	62	174
Unit 2	30	0	30
TOTALS	**142**	**62**	**204**

Assuming that the design population will be controlled by the current number of available lots, the design sewer flows can be estimated for the current developed and undeveloped properties.

Table 2-3
Wastewater Flow Projections

	Population	Design Unit Flow	Projected Avg. Daily Flow, ADF	Design Peak Hour Flow, PHF [2]
		GPD/EDU[1]	GPD	GPM
Unit 1				
Developed	560	350	196,000	510
Undeveloped	179	350	62,650	163
Unit 1 Total	**739**		**258,650**	**674**
Unit 2				
Developed	606	350	212,100	552
Undeveloped	20	350	7,000	18
Unit 2 Total	**626**		**219,100**	**570**
Total Units 1 & 2	**1,365**		**477,750**	**1,244**

1 - Design unit flow based on 100 gpd / person and an average population of 3.5 persons per EDU (lot).
2 - PHF = 3.75 x ADF /1440 (3.75 Peaking Factor per 10-State Standards for Wastewater Facilities, 1997 - Fig.1, Ch.10, p.5)

2.2 Project Timing and Phasing

Project Timing

Time to complete design and construction is an important element in this evaluation. The County would like to have the collection system, or at least a significant portion of the collection system, on-line and functioning before the moratorium expires in July 2006.

There are several critical elements that affect the timing and ultimately the successful completion of the project. First, obtaining a commitment from a utility service provider and agreement to terms of service must be accomplished before design can begin. The service provider selection will have certain requirements for system requirements, which will directly affect the design and construction of the project. Second, the selected sewer system technology will have a significant impact on the time to obtain survey data and to design, bid, and construct the collection system. The estimated time for obtaining survey data and to design, bid, and construct the system for the various sewer system alternatives is a follows:

Table 2-4
Estimated Project Schedule Summary

	Time to Complete (months)		
Sewer Alternative	**Survey, Design, & Permitting**	**Bid & Construct**	**Total**
Gravity	12	18	30
Vacuum	12	15	27
Low-Pressure	6	12	18

Note: These time estimates assumes no delays related to the utility service provider issues above.

And finally, the County must provide authorization to proceed with design. If authorization is not received in a timely fashion, it becomes increasingly more difficult to complete the project by the moratorium deadline.

Project Phasing

One possible way to facilitate the design and construction would be to break the project into two phases - breaking down the survey, design, and construction effort into two separate parts. Based on the number of undeveloped lots and septic tank failures identified in Tables 2-1 and 2-2, Unit 1 would be the logical choice for Phase-1 and Unit 2 would follow as Phase-2.

One significant advantage of breaking the project into two phases is that if Talquin were to provide sewer service for Units 1 & 2, phasing the project may allow them to utilize some of their existing treatment and disposal capacity for Phase-1; while allowing them time to design, permit, and construct the improvements needed to expand the treatment and disposal capacity to accommodate the entire project area.

SECTION 3
WASTEWATER COLLECTION SYSTEMS

3.1 General

Neighborhood Impacts

In order to facilitate construction and minimize delays, careful consideration to residential impacts should be considered when evaluating the alternative sewage systems. The most obvious impacts to the neighborhoods are those resulting from construction activity. Concerns related to existing utility service, maintenance of traffic, access to property, public safety, noise, and others must be considered during design and construction. Additionally, there are also impacts that result from the operation and maintenance of the collection system, both physical and financial. Physical impacts include items such as noise, odors, lighting, and public safety. Financial impacts may include items such as assessment fees, increased electrical consumption, and monthly service fees.

Maintenance Responsibility

If any equipment is to be owned and maintained by the homeowner, as with their existing septic tank system, the costs associated with routine maintenance and operation would typically be the responsibility of the homeowners. If the equipment is to be owned and maintained by the municipality, the utility service provider, or a third party, the costs associated with routine maintenance and operation will be the responsibility of that entity. Having canvassed several utility maintenance entities regarding their operation and maintenance practices, most of the municipalities owned and maintained all components of the sewage system; even when the equipment was located on private property. Additionally, maintenance entities generally recovered the associated maintenance costs through their regular monthly service fees or a through special maintenance assessments.

3.2 Gravity Sewer Systems

General Operation

A gravity sewer system is a non-mechanical process for collecting and transporting domestic wastewater, and is perhaps the most desired and most common type of collection system in use throughout the world. It is simple in design and operation, and requires virtually no maintenance throughout its design life when installed correctly. Gravity sewer systems typically have no mechanical equipment in the collection system and rely solely on the slope of the pipe in order to convey the sewage through the piping system.

Domestic sewage flows by gravity from the house to the service connections located at the property line. The sewage continues to flow by gravity through a pipe network to a common collection point. At this location, a central pumping station is usually installed in order to lift the sewage to another gravity system or transport the sewage to its final destination for treatment and disposal. This central pumping station is the portion of the gravity system that requires the most maintenance; it requires power to operate; and can be readily equipped with an emergency generator to function during power outages.

Because gravity systems rely on the slope of the pipe for conveyance, the pipes can get very deep; as a result, the installation is typically more difficult due to the depth of excavation, thus increasing the cost of construction. To avoid deep installations, additional pump stations may be installed in order to lift the sewage so that it can return to gravity flow at a shallower depth. Installing lift stations to avoid deep excavations may make the collection system construction easier, but it introduces mechanical equipment which then requires electricity and more frequent maintenance.

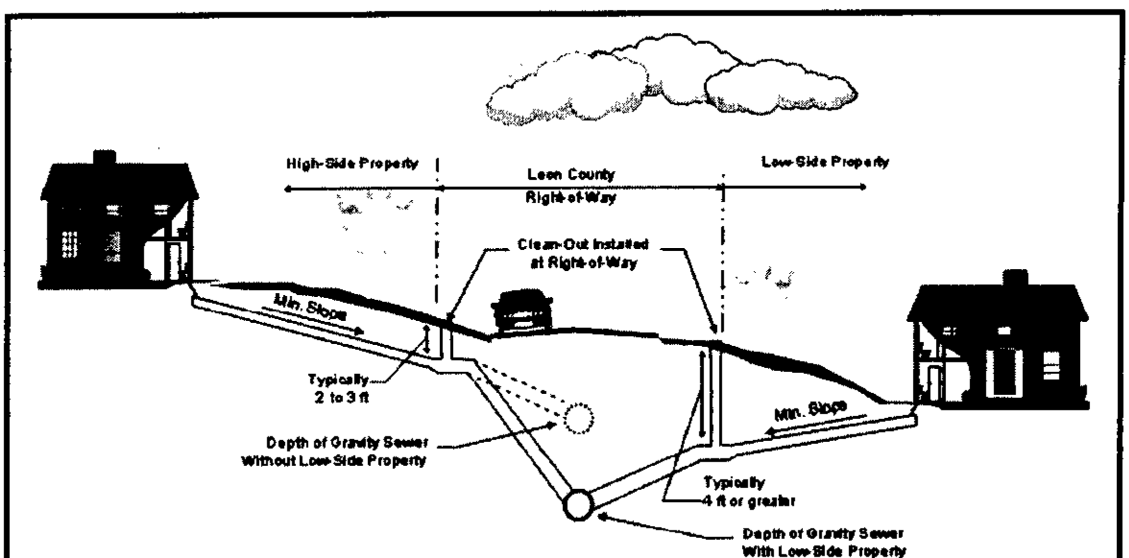
History and System Reliability

Because there is no need for mechanical equipment in the collection system except for the central pump stations, the only remaining influences as to the reliability of a gravity system are the materials of construction and the quality of installation. Poor materials and workmanship will lead to such problems as inflow and infiltration, reduced capacity, increased maintenance, and eventually reduced design life. Improvements in materials and construction methods have come a long way over the last 30 years, and both are factors that can be controlled by quality specifications and quality field inspection.

Construction Methods and Limitations

In Killearn Lakes Units 1 & 2 there are several areas where houses on one side of the street are higher than the road, and houses on the other side of the street are lower than the road (Figure 3-1). In a gravity system, there are three ways to deal with these existing conditions;

Figure 3-1
Typical Subdivision Cross-Section



either construct deeper sewer mains to accommodate the low-side lots; construct a second parallel gravity sewer main behind the low-side lots and serve them from the rear; or construct a low-pressure grinder pump station or septic tank effluent pump (STEP) station to pump the sewage up to the main. All three conditions are undesirable and increase the cost or O&M of a gravity collection system.

Gravity sewers need to be installed at precise slopes in order to achieve minimum velocity and to avoid dips in the pipe. Except in special circumstances, gravity sewer installation does not generally benefit from the use of alternative construction techniques such as horizontal directional drilling or other "trenchless" construction methods. While there are some trenchless technologies (such as micro-tunneling) that can install pipes on grade, their costs are generally prohibitive.

Construction of conventional sewage pump stations is generally simple. A large concrete wetwell, usually 6-10 feet in diameter, collects the sewage from the gravity sewer system. Submersible sewage pumps are typically installed directly in the wetwell, as opposed to construction a wetwell/dry structure. This reduces pump station site requirements and also reduces the noise from the system because the pumps are most frequently running under submerged conditions. Fluid level sensors or switches operate the pumps. Additionally, with some creative planning and design, the conventional sewage pump station structure and controls can be made to blend with the neighborhood housing (if needed), creating an unobtrusive facility that is easy to access and maintain.

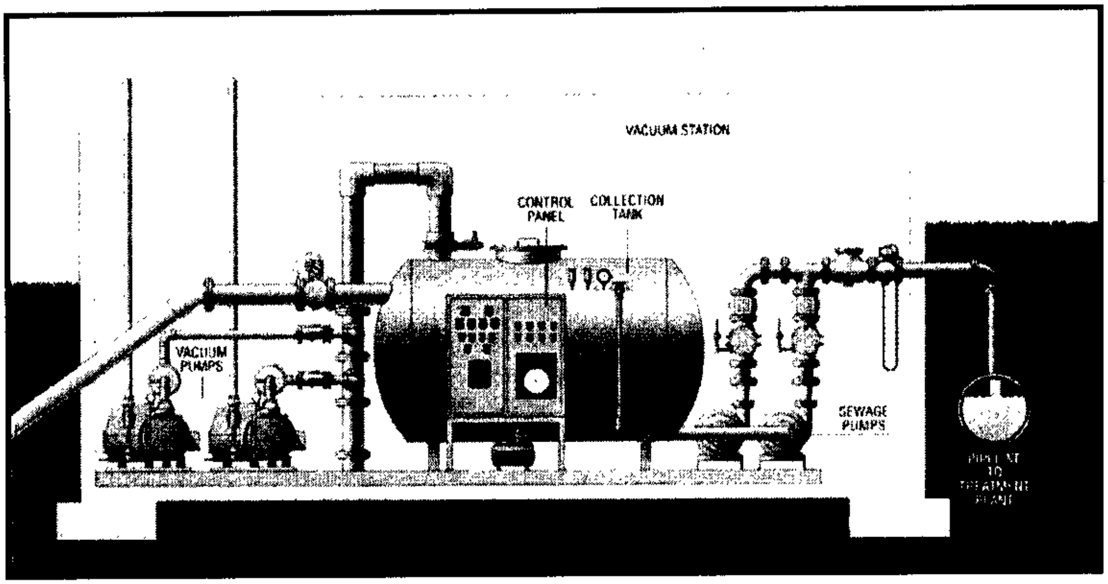
3.3 Vacuum Sewer Systems

General Operation

The vacuum sewer system is a mechanical process of transporting wastewater that is widely accepted as an alternative technology for collecting and transporting domestic sewage. Vacuum systems rely on negative differential pressure in the main collection/conveyance system for operation. In general, domestic sewage generated from the house flows to a small sump, or valve pit, that is located at the right-of-way the line. When a given quantity of sewage is accumulated in the valve pit, a valve is activated and the sewage is drawn into the collection system and conveyed to a central location, where it may then be re-pumped or treated. Vacuum sewer systems have three main components that are essential to their operation - the vacuum station, the collection system piping network, and the valve pit.

The vacuum station (Figure 3-2) is the heart of the vacuum sewer system. It consists of vacuum pumps, a vacuum reservoir tank, a wastewater collection tank, wastewater pumps, and electrical controls. The vacuum pumps generate the negative pressure needed to operate the system. The pumps are sized similarly to conventional pump station pumps - utilizing two pumps (one lead pump and one lag pump), each designed to handle 100 percent of the system demand on its own, and typically operate 4 to 6 hours per day. The vacuum pumps utilize a vacuum reservoir tank that acts similar to a hydropneumatic tank, storing negative pressure and reducing the frequency of vacuum pump starts, thus extending the pump life. The vacuum station is also the central collection point of the wastewater. The wastewater is accumulated in a collection tank, and then the wastewater pumps transport the sewage to the treatment plant. The wastewater pumps are generally non-clog with sufficient net positive suction head (NPSH) to overcome the negative pressure of the vacuum reservoir tanks. Fluid level and pressure sensors monitor and regulate the operation of the system. The vacuum station is the portion of the vacuum system that requires the most maintenance; it requires power to operate; and can be readily equipped with an emergency generator to function during power outages.

Figure 3-2
Typical Vacuum Station Diagram

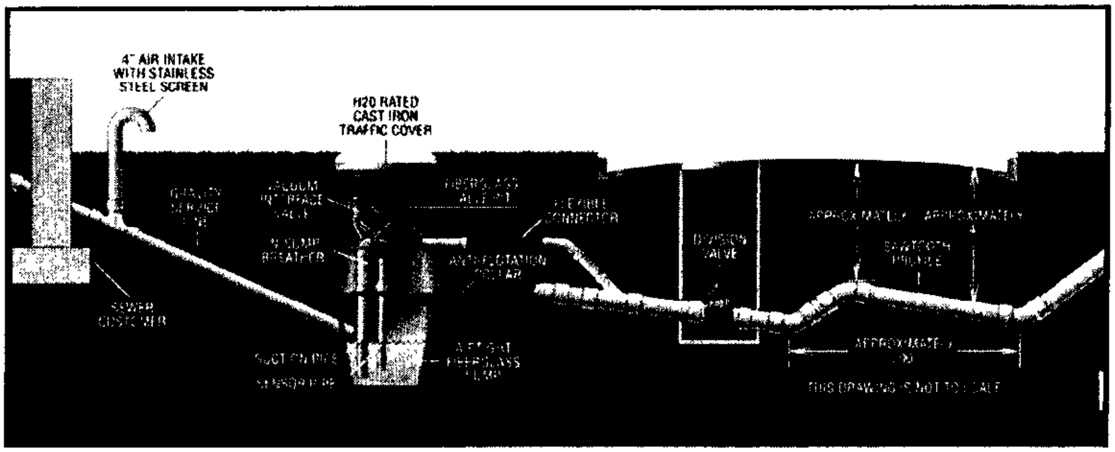


Vacuum Station Diagram provided by AIRVAC, Inc.

The vacuum collection system piping network (Figure 3-3) generally consists of plastic piping in sizes as small as 4-in. diameter; however, smaller pipe sizes are not recommended. Additionally, the pipe, joints, and gaskets used for vacuum system piping must be approved for vacuum service. The vacuum system piping network uses both gravity sewer and pressure sewer concepts. The vacuum system utilizes gravity flow throughout the system - generally laying the pipe with the down-hill slope of the ground with a minimum slope of 2-percent. For uphill transport and to minimize the excavation depth, lifts resembling a "saw-tooth" pattern are installed in the piping. This creates pockets of sewage (often referred to as "slugs") in the collection system. Each time a vacuum valve opens, the negative pressure in the piping draws the slug of sewage up and over each lift, and then the sewage flows by gravity to the next "saw-tooth" in the piping network. This process is repeated continuously throughout the system until the sewage reaches the vacuum station. The installation of the vacuum collection system piping also follows the same principals as water distribution piping, installing valves on branches and periodically on the mains in order to isolate sections when repairs are needed. This saw-tooth profile requirement adds to the complexity of the design and construction of the vacuum system piping.

The valve pit is the third and final component of the vacuum collection system (Figure 3-3). They are typically made of fiberglass and divided in to two halves - top and bottom. The bottom half is an air-tight sump (typically 30 gallons) that accumulates the domestic sewage from the house. The top half houses the Vacuum Interface Valve - a pneumatically operated valve that opens and closes with differential pressure generated by the collection of sewage in the sump. When the valve is actuated, the sump is evacuated and the sewage is pulled into the collection system piping, and the valve is automatically closed. Typically this cycle is set to run between 3 and 30 seconds, depending on the size of the sump and volume of sewage. The valve pit is typically installed at the right-of-way line and has either a light-weight aluminum lid or cast-iron lid, depending on the loading. Additionally, an anti-flotation collar may also be required in certain conditions.

Figure 3-3
Typical Vacuum Collection System Piping and Valve Pit Diagram



Valve Pit and Piping System Diagram provided by AIRVAC, Inc.

<u>History and System Reliability</u>

Vacuum sewer systems have successfully been in operation in the United States and other countries for over 30 years. Once thought only to be viable for smaller systems (less than 1,000 connections), the trend towards larger vacuum sewer systems has grown since the 1990's. Since then, larger systems have become more common and are operating successfully, including a system in Englewood, Florida that serves over 8,000 connections. And with technological advances and competition in the marketplace, the systems have become very reliable and cost-effective in recent years.

As with any sewage collection and transmission system, how well the system operates is largely dependent upon the materials of construction and quality of installation. Poor materials and workmanship will lead to such problems as inflow and infiltration, reduced capacity, increased maintenance, and eventually reduced design life. Through the use of quality specifications and quality field inspection, experienced utility contractors working with experienced field representatives will ensure that the system is installed correctly and will help minimize future maintenance.

Construction Methods and Limitations

In a vacuum system, there are three possible ways to deal with these existing grade conditions - where houses on one side of the street are higher than the road, and houses on the other side of the street are lower than the road. First, the vacuum piping can be installed slightly deeper so as to reduce the amount of lift, or suction, required to empty the valve pit. This option is limited by the amount of lift, or negative pressure, available in the vacuum system. Second, a second parallel vacuum sewer main behind the low-side lots can be constructed to serve them from the rear. This option has a substantial impact on the green spaces and disruption to the neighborhood. And finally, a low-pressure grinder pump station or septic tank effluent pump (STEP) station can be installed to pump the sewage to a buffer tank so the vacuum system can pick up the sewage. This option introduces additional mechanical equipment that requires electrical power to operate. All three conditions increase the design effort as well as the cost O&M for a vacuum collection system

The vacuum system piping uses valves and fittings in order to isolate sections of the collection system and to construct the saw-tooth profile. Because the pipe is installed on precise slopes, their installation does not benefit from the use of alternative construction techniques such as horizontal directional drilling or other "trenchless" construction methods. However, smaller pipes and shallower depths facilitate the ease of installation and cost savings.

The valve pits are typically installed at the right-of-way line and need to be set at an elevation that allows the private building sewer to be installed at minimum slope (approximately ¼" fall per foot of 4-inch service pipe) from the house or septic tank to the valve pit sump. Because of the existing grades, there may be circumstances where the valve pit is installed closer to the house. In such instances, the private building sewer would be constructed like the main collection system piping, using saw-tooth steps and negative pressure from the piping system to pull the flow up and into the piping network located in the right-of-way.

Construction of the vacuum station is relatively easy to install since most of it can be delivered to the site preassembled by the equipment manufacturer. And with some creative planning and design, the vacuum station structure can be made to blend with the neighborhood housing, creating an unobtrusive facility that is easy to access and maintain.

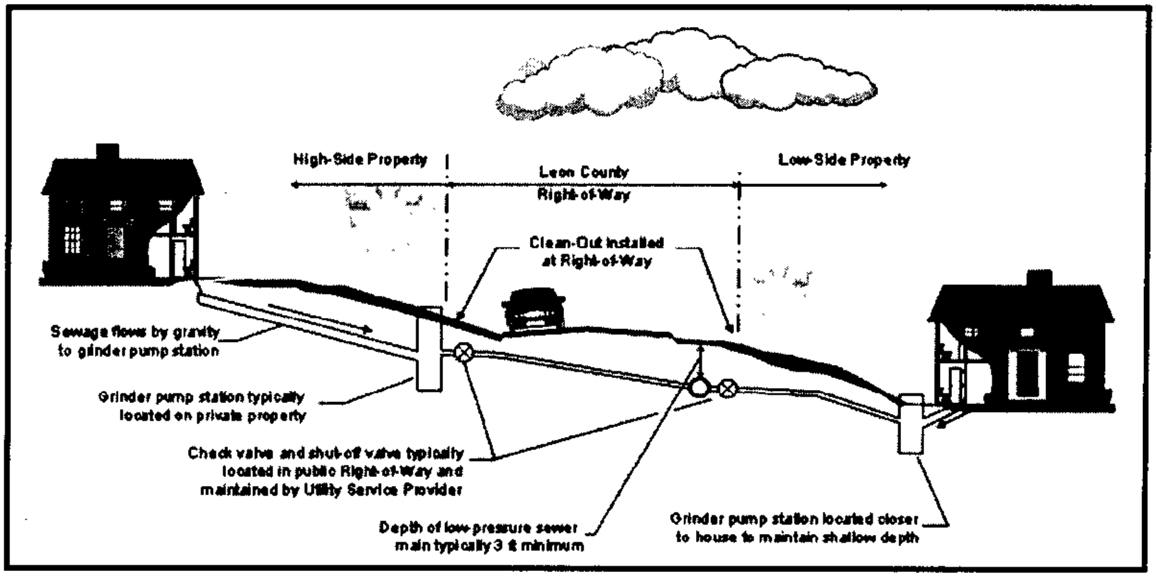
3.3 Low-Pressure Sewer System

General Operation

The low-pressure sewer system is another mechanical process of collecting and transporting domestic sewage that is widely accepted. The system relies on individual pump station packages that collects raw domestic sewage generated from the house, or partially (primary) treated sewage from the septic tank (STEP system), and pumps the sewage into the low-pressure piping network where it is transported to a central location for treatment or re-pumping. Low-pressure sewer systems have two main components that are essential to their operation - the low-pressure piping network, and the grinder pump station.

The low-pressure system piping generally consists of small diameter plastic pipes as small as 1½ inches in diameter. Additionally, the pipe, joints, and gaskets must be approved for low-pressure service. In general, the installation of the low-pressure sewer system piping follows the same principals as water distribution piping - burying pipe at minimum cover, installing valves on branches and periodically on the mains in order to isolate sections when repairs are needed, and installing air-release valves at the high points to avoid air-locks.

Figure 3-4
Typical Low Pressure Sewer Configuration



The grinder pump station is the other critical component of a low-pressure sewer system. They consist of a wetwell that is typically 4 - 6 feet deep and made of fiberglass, plastic, or steel. The wetwell collects the domestic sewage from the house. When the wetwell fills to a preset level, a float switch (or other liquid level switch) turns the pump on, and the sewage is pumped out. Typically, the cycle is repeated based on the recommended number of start/stop cycles recommended by the pump manufacturer and the sewage flow from the house. The wetwell can be installed at the right-of-way line or in the vicinity of the existing septic tank system, and has typically either a light-weight aluminum lid or cast-iron lid, depending on the loading. Additionally, an anti-flotation base may also be required in certain conditions. Figure 3-4 illustrates the typical low-pressure piping system and grinder pump station configuration in relation to the public and private properties.

The complex element to the design of the low pressure sewer system is the hydraulic evaluation. This is done to determine pipe sizes and select the most appropriate pumps for the application. Once the hydraulic analysis is completed, the remainder of the system design is straight forward and can be completed quickly.

History and System Reliability

Low-pressure sewer systems have successfully been operation in the United States and other countries for decades. Technological advances in grinder pump station components (motors, cutters, etc.) and competition in the marketplace has created very reliable and cost-effective systems in recent years. They have been installed in applications as small as a single unit and as large as several thousand units.

As with any sewage collection, how well the system operates is largely dependent upon the quality of the equipment and materials and how well it is installed and maintained. Poor materials and workmanship will lead to such problems as inflow and infiltration, reduced capacity, increased maintenance, and eventually reduced design life. Through the use of quality specifications and quality field inspection, experienced utility contractors working with experienced field representatives will ensure that the system is installed correctly and will help minimize future maintenance. Proper maintenance of a low-pressure system is both a function of the homeowner and the maintenance entity (which can also be the homeowner).

An effective public education program can significantly reduce the amount of maintenance required for a low-pressure system. The mechanical components of a grinder pump station are susceptible to damage from items put into the house plumbing (via toilets or garbage disposals. Abrasive items such as cat litter or chicken bones will often wear the pump, thus causing it to fail.

Construction Methods and Limitations

Grinder pump station often come entirely pre-assembled and ready to drop in the ground. The bottom depths of the grinder stations are relatively shallow and can often be concealed with landscaping, but the stations must remain accessible for maintenance.

The low-pressure system piping is not required to be installed at a fixed slope or with any special profiles, which facilitates the use of alternative construction techniques such as horizontal directional drilling or other "trenchless" construction methods. Low-pressure piping can be installed at a minimum depth, usually 3 - 4 feet below finished grade. This reduces the need for restoration of roads, right-of-way, and existing utility systems, which facilitates further cost savings.

Installation of the service connections from the mains to the rights-of-way can be a relatively simple operation and require very little disruption. Service laterals can often be jetted across roadways to avoid disruption of existing utilities, roads, and traffic. The grinder pump stations are typically installed at the right-of-way line and need to be set at an elevation that allows the private building sewer to be installed at minimum slope (approximately ¼" fall per foot of 4-inch service pipe) from the house or septic tank to the grinder station. Because of existing grades, the pump station may need to be installed closer to the house, and then utilize the pressure from the grinder pump station to push the flow up and into the piping network located in the right-of-way.

SECTION 4
COLLECTION SYSTEM COMPARISONS

4.1 Gravity Sewer System

The gravity sewer collection system has several advantages and disadvantages when compared to the low-pressure and vacuum sewer systems. The most noteworthy advantages include:

- No mechanical equipment to install at the property line.
- Virtually maintenance-free collection system.
- In areas with substantial grade changes, proper planning can significantly reduce the number of pump stations in the system.
- Central pump stations can be installed with emergency generators to operate during power outages.

The main disadvantages of the gravity sewer collection system are:

- When installed in an existing neighborhood, gravity sewer mains have a substantial impact on existing utilities and roadways, causing high restoration costs.
- Slow installation prolongs disruptions and inconvenience to residents.
- Because of the existing grades, deeper and parallel sewers in the green spaces are requires to serve several streets.
- Some lots will require grinder pump stations due to their location and elevation.
- Central pump stations are expensive to construct, operate, and maintain.
- The estimated cost to construct a gravity system is much greater than the vacuum and low-pressure sewer systems.

4.2 Vacuum Sewer System

The vacuum sewer collection system has several advantages and disadvantages when compared to gravity and low-pressure sewer systems.

<u>Vacuum - Gravity Comparison</u>

When compared to a gravity sewer system, the most noteworthy advantages of a vacuum system include:

- The depth of installation remains relatively shallow.
- Shallow depths are easier to construct and have far less impact to neighborhood streets.
- Smaller diameter pipes as little as 4-inch diameter reduces cost of main line materials and installation.
- High velocities breakdown the solids in the sewage and prevent odors from accumulating.
- No manholes required to make bends.

The main disadvantages of the vacuum system when compared to gravity systems are:

- The pipe is laid with a "saw-tooth" profile, which is more difficult to install than a straight profile.
- The vacuum station is typically larger, more expensive, and more complex to operate and maintain than conventional sewage pump stations.
- The valve pits require maintenance.
- Impacts to existing utilities are high resulting in higher restoration costs, slower construction, and prolonged disruption and inconvenience to the residents.
- Because of the existing grades, parallel sewers are needed to serve all of the lots.
- There are some locations that will require grinder pump stations and buffer tanks.

Vacuum - Low-Pressure Comparison

When compared to low-pressure sewer system, the most noteworthy advantages of a vacuum system include:

- Vacuum interface valves require less maintenance than grinder pump.
- Vacuum interface valves are easier to repair and/or replace.
- Vacuum valves do not require electrical power at the valve to operate.
- Odors are less of a concern.

The main disadvantages of the vacuum system when compared to low-pressure systems are:

- Slow installation prolongs disruptions and inconvenience to residents.
- The vacuum mains are typically larger and more expensive than those for low-pressure sewers.
- The vacuum system piping is installed on precise slopes, much the same way as the gravity sewer system piping installed, but with a few significant differences.
- Impacts to existing utilities are high resulting in higher restoration costs, slower construction, and prolonged disruption and inconvenience to the residents.

4.3 Low-Pressure System

The low-pressure sewer system has several advantages and disadvantages when compared to gravity and vacuum sewer systems. The most noteworthy advantages include:

- Low-pressure mains are typically smaller than those for vacuum and gravity sewer.
- Low-pressure mains are typically installed shallow and do not require installation on grade or with special profiles.
- Shallow depths are easier to construct and have far less on existing utilities and roadways.
- Pressure mains can be installed using trenchless construction methods which can provide significant cost savings and minimize disruption of other utility services.

- The system can be designed and installed relatively quickly.
- The estimated construction cost of a low-pressure system is substantially less.

The main disadvantages of the low-pressure system when compared to gravity and vacuum systems are:

- The grinder pump stations have an initial capital cost that is typically born by the homeowner.
- Grinder pump stations require regular maintenance for the life of the system.
- Unlike the gravity and vacuum sewer systems, the grinder pump stations require electrical power to operate - the system will not operate during a power outage.
- Air-release valves are required at high pints in the system and will require regular maintenance to avoid air-locks.
- There is a potential for odors from aging sewage and air-release valves.

SECTION 5
ESTIMATE OF PROBABLE COSTS

5.1 General

In order to confidently evaluate the cost of each collection system alternative, we utilized the preliminary design layouts developed during the study. To accurately estimate the costs associated with construction, operation, and maintenance of the three sewer alternatives, the PBS&J design team used the assistance of representatives from the low-pressure and vacuum sewer manufacturers, local equipment suppliers, and sewer contractors. The cost estimates were created using sound engineering practice with sufficient accuracy to estimate costs for planning purposes. And while it is recognized that there may be several factors that could affect the cost for each alternative, the evaluations were adjusted to make the systems equitable. Determining the most cost-effective sewer layout of the recommended sewer system alternative will be performed during the design phase.

The operation and maintenance cost is a recurring, or perpetual cost. This cost is generally incurred by the utility service provider, and recovered from the homeowners through service and maintenance fees, depending on the type of system.

A summary of the estimated collection system construction cost and operation and maintenance costs is presented in Table 5-1 below. A detailed breakdown of the cost estimates is included in the Appendix A and B.

Table 5-1
Cost Estimate Summary

Alternative Sewer Technology	Total Collection System Cost (Public R-O-W)	Total Service Connection Cost (Private Property)	Total Construction Cost	Annual Operation & Maintenance Cost
Gravity	$21,500,000	$6,800,000	$28,300,000	$33,000
Vacuum	$13,600,000	$6,800,000	$20,400,000	$103,500
Low-Pressure	$4,800,000	$11,700,000	$16,500,000	$106,000

Notes - Costs presented in Table 5-1 above:

1. Include costs of engineering; construction administration; mobilization, bonds, and insurance; and public information.
2. For low-pressure sewer, Open-Cut construction method is presented. HDD construction method is approximately 10% lower.
3. Operation & Maintenance cost is an annual and perpetual cost.
4. All costs are in 2004 dollars

SECTION 6
UTILITY SERVICE PROVIDERS

6.1 Utility Service Provider (USP)

As part of the evaluation of sanitary sewer systems, an investigation into the potential utility service providers was performed. The purpose of the investigation was to determine which USP has available capacity in their collection/transmission system and wastewater treatment and disposal facilities; which are willing to own, operate, and maintain the collection system; what type system would they be willing to own, operate and maintain; and would they be willing to provide financial assistance towards the construction or service connections. Within Leon County, there are only two existing utility service providers that are positioned to be able to provide sanitary sewer service to Killearn Lakes Units 1 and 2 - they are Talquin Electric Cooperative (Talquin or TEC) and City of Tallahassee.

In order to establish the position of each USP for the project, PBS&J prepared a questionnaire that was sent to Talquin and the City of Tallahassee on October 8, 2004. Upon distribution of the questionnaire, PBS&J requested that each agency to respond to the questions. The questions fell into three basic categories - financial, operation and maintenance, and system capacity - and are shown in Figure 6-1 below.

Figure 6-1
Utility Service Provider Questions for Sanitary Sewer Service
For Killearn Lakes Plantation Units 1 & 2
(Note, there are approximately 1400 potential customers in these two units.)

Financial:

What would be the upfront fees associated with connecting to your system; connection charges, facilities charges, other? Would they be the same for gravity, vacuum, or low pressure?

What would be the monthly charges for sewer service in Killearn Lakes? Would they be the same for gravity, vacuum, or low pressure?

Is there a credit or waiver or reimbursement available that could be credited to the individual units in Killearn Lakes for connecting to a sewer system that is constructed by Leon County?

Would you be willing to participate in the cost of constructing a sanitary system in this area?

Would you be willing to finance the cost of the grinder station and include the payback as part of the monthly sewer charge?

If the property owner owns and maintains a low-pressure grinder pump, can connection fees be waived or credited back?

Figure 6-1 (Continued)
Utility Service Provider Questions for Sanitary Sewer Service
For Killearn Lakes Plantation Units 1 & 2
(Note, there are approximately 1400 potential customers in these two units.)

Operation and Maintenance:

Would you be willing to own and maintain lines and service connections associated with an alternate sanitary system such as vacuum or low-pressure?

What level of service, if any, would you be willing to provide to customers on low pressure grinder pump stations for their individual lots? Would there be an additional fee for this maintenance? Would you consider owning and/or maintaining the individual pumping system at each home site?

Do you have standards for alternate sewer systems such as vacuum and low-pressure systems? Do you currently own, operate, or maintain alternate sewer systems?

If you have low pressure sanitary systems already, how are they owned and maintained?

Existing System/Conditions

What is your ability to serve these 1400 units with sanitary service in terms of capacity at the WWTP and in terms of conveyance to the WWTP. If you cannot serve all 1400 units at this time, in what time frame would treatment and or conveyance capacity be made available? If you cannot serve 1400 units at present, how many can you currently serve?

Can you provide information showing where connections to your system are currently available and what the conveyance capacity is at each of these locations?

The following paragraphs summarize the responses to questionnaire from the two potential utility service providers:

6.2 Talquin Electric Cooperative

Talquin currently provides water and sewer service to Killearn Lakes Unit 3, Golden Eagle, and other subdivisions with the Killearn Lakes Plantation community. It also provides water service to Units 1 and 2 of Killearn Lakes Plantation. As such, they would be considered as the most likely USP for sewer service in Units 1 & 2. However, the Talquin wastewater treatment plant does not currently have available capacity to receive the sewage from Units 1 & 2. In order to provide treatment and disposal capacity, Talquin would have to upgrade/expand their existing wastewater treatment and disposal facilities. The time frame for designing, permitting and constructing the needed improvements for expansion could take several years; and for the purpose of this study, in order to meet the time frame of the moratorium, Leon County requested that other possible USP options also be investigated.

In response to the same questionnaire, Talquin Electric indicated that their current obligations for providing wastewater capacity at their facility have consumed most of the capacity of their 0.7 MGD plant. Additionally, they indicated that they could not guarantee that capacity would be available in two years time, when the collection system for Units 1 and 2 is anticipated to come on line. Talquin did indicate some concerns surrounding the alternative collection system technologies (vacuum and low-pressure sewer systems), primarily due to the operating and maintenance of these systems, and also because of the potentially long residence time of the wastewater (low-pressure), in the event that mandatory connection to the new system is not required. Talquin did indicate that they are currently looking at several options in order to provide sewer service for Killearn Lakes Units 1 & 2.

Talquin's current standard fees for providing wastewater service are presented in the Table 6-2 below; however, they indicated that these fees are not guaranteed to be applicable to this project.

Table 6-1
Talquin Electric Cooperative Typical Sewer Fees

Fee Description	TEC Fees	County Surcharge	Total Fee
System Charge	$3,650	n/a	$3,650
Connection Fee	$ 520	n/a	$ 520
Deposit	n/a	n/a	n/a
Capital Cost [1]	$4,450.00		$4,450
Total Homeowners Fee			$4,170
Monthly Service Charge [2]	$ 28.78	n/a	$ 28.78

1 - Based on one low-pressure grinder sewer pump station per lot and septic tank demolition.
2 - Based 3/4" service and average monthly consumption of 6,000 gallons - $19.80 + ($1.41/1000 gal x 5000 gal) + (1.93/1000 gal x 1000 gal)

Talquin indicated that they would not expect to participate in the capital cost of constructing the collection system; however; they do anticipate a significant capital investment to upgrade the wastewater treatment and disposal facility in order to provide service to this area. Talquin also indicated that there are no waivers or reimbursements available to the homeowners for constructing the private side connections to the system and that they do not have the ability to assist with financing the homeowners fees associated with those connections.

6.3 City of Tallahassee

For the City to be able to provide sewer service to Units 1 & 2, the sewage will need to be pumped and tied-in to the City's collection/transmission system near the intersection of Thomasville Road and Velda Dairy Road, which is approximately two miles from the Killearn Lakes subdivision.

Based on preliminary discussions, the City of Tallahassee has indicated that they have capacity within their collection and transmission system, as well as their treatment and disposal facilities to accept sewage from all 1365 lots within Killearn Lakes Plantation Units 1 & 2, and would be willing to consider the opportunity to provide sewer service. They also indicated that they would be willing to own and maintain the sewer infrastructure within public right-of-way for the standard sewer service fees; and for an additional monthly maintenance fee, they would consider maintaining the private side mechanical equipment such as a grinder station or vacuum valve pit.

The City indicated that they would not be willing to participate in the cost of the collection system unless they were able to take over operation of the public water system in Units 1 & 2. However, the City would consider waiving the connection fee, if the connection were made by the contractor during construction of the collection system. And finally, the City has a low-interest loan program that could be offered to the residents to help finance the all of the costs associated with connecting to the new system, including demolition of their existing septic tank.

The up-front fees associated with providing sewer service would be the same as those fees imposed within City Limits and are listed in Table 6-2 below:

Table 6-2
City of Tallahassee Typical Sewer Fees

Fee Description	City Fee	County Surcharge	Total Fee
System Charge	$2520.00	1.375	$3465.00
Connection Fee	$ 450.00	included	$ 450.00
Deposit [1]	$ 40.00	n/a	$ 40.00
Capital Cost [2]	$4450.00		$4450.00
Total Homeowners Fee			**$8405.00**
Monthly Service Charge [3]	$ 24.48	1.375	$ 34.21

1 - Refundable after one year of service.
2 - Based on one low-pressure grinder sewer pump station per lot and septic tank demolition.
3 - Based on fixed fee of $8.40 + $2.68/1000 gallons; and average monthly consumption of 6,000 gallons

SECTION 7
SUMMARY AND CONCLUSIONS

7.1 General

Prior to making a selection as to the desired sewer alternative it should be noted that, for the purposes of estimating the costs within this report, it was assumed that all of the wastewater flow generated from this project will be connected to the City of Tallahassee's collection, treatment, and disposal system, which is the most costly alternative. While this assumption may not be final, it provides for a conservative cost estimate and immediate wastewater treatment and disposal capacity.

Furthermore, while it may seem obvious that the least expensive system would be the most desirable, careful consideration should be given to operation and maintenance issues (other than costs) for each of the alternatives before a final selection is made.

7.2 Summary

Gravity Sewer Alternative

While the gravity sewer system offers the home owners a nearly maintenance-free collection system throughout the design life of the system, the capital cost of constructing the gravity sewers within Killearn Lakes Units 1 & 2 is considerably higher. This, combined with the O&M costs of a master pump station, and the O&M costs of several grinder pump stations to serve the low-elevation flag lots, creates a substantially more expensive system than the vacuum and low-pressure sewer alternatives.

The main factors contributing to the added cost of the gravity system are the depth of installation of the sewer collection system, the restoration of public right-of-way, the added infrastructure required to serve the low-side properties from the green spaces behind the homes, and anticipated utility repair costs resulting from installing sewer retroactively as opposed to sewer construction within a new community.

Finally, in consideration of the time to design, bid, construct, and place into operation; the gravity sewer alternative takes the greatest time to complete and does not meet the time constraints of this project.

Vacuum Sewer Alternative

The vacuum sewer system also offers the homeowners a nearly maintenance-free collection system on private property, so long as the vacuum pits are to be maintained by the utility service provider. In such a case, the homeowner would not experience any significant difference between a vacuum and gravity collection system. On low-side properties, the valve pits would likely need to be located closer to the home, and therefore a maintenance access agreement will be required in order for the utility service provider to maintain the equipment.

Although the total cost of the vacuum system includes the cost for three vacuum stations, the construction cost of the vacuum system is substantially less than the gravity system, primarily because the collection system piping is much shallower. The O&M costs for a vacuum station are the highest among the alternatives, primarily because of the O&M costs associated with the three vacuum stations.

Additionally, since neither of the potential utility service providers has any experience with vacuum systems, there is concern that this alternative could be perceived as "experimental." And while this would not normally be considered a big obstacle with most communities, Killearn Lakes Units 1 & 2 is in this situation because of past "experimental" infrastructure solutions. If the County were to proceed with this alternative, there would likely need to be a substantial public education effort in order to appease County officials and the residents of the community. Add this to the need for operator training involved in order having a maintenance crew prepared to service the vacuum equipment. While these are not prohibitive factors, they do contribute to the complexity of the project.

Finally, in consideration of the time to design, bid, construct, and place into operation; the vacuum sewer alternative can be completed in less time than the gravity system, but more than the low-pressure system alternative, and does not meet the time constraints of this project.

Low-Pressure Sewer Alternative

The low-pressure sewer system would not have the same private property low-maintenance characteristic as the gravity and vacuum sewer alternatives because neither of the utility service providers would be willing to assume ownership of the grinder stations. Furthermore, the low-pressure system is the only system alternative that requires electrical power at all of the service connections to operate. Having evaluated the power consumption and costs associated with providing power to operate a grinder pump station, this may not seem like a critical concern. However, in light of the recent hurricane season (2004), where extended power outages were prevalent throughout the Florida; there were several communities that rely on low-pressure sewer systems responded to homeowner complaints of sewer backups as a result of the residents continuing to use the household plumbing (showers, toilets, bathtubs, etc.) while the grinder pump stations could not operate due to the loss of power.

Finally, in consideration of the time to design, bid, construct, and place into operation; the low-pressure sewer alternative takes the least time to complete and is the only alternative that meets the time constraints of this project.

7.3 Conclusions

Based on the information presented in this report, it is not recommended that a vacuum system be considered as a viable solution for this project. Considering the combination of natural topography, disruption to the neighborhood, time to complete, and operation and maintenance cost associated with the vacuum system, it does not offer any substantial advantages over the gravity and low-pressure sewer system options. As such, the following conclusions are made to assist the County with selecting a sewer system alternative that serves the needs of the residents of Killearn Lakes Units 1 & 2.

- If time and cost was not a factor in the decision, the gravity sewer system is most reliable solution and offers the lowest operation and maintenance effort and cost.
- To save substantial time and cost, the low-pressure system is the also a reliable solution, but does have some drawbacks in long-term operation and maintenance of the grinder pump stations.

Appendix - A
Construction Cost Estimates

Killearn Lakes Units 1 & 2 Municipal Sewer System Evaluation
Gravity Sewer Option
Open-Cut Construction
D-3034 / SDR35 PVC - Gasketed Sewer Pipe

			Materials		Labor		
Description	Qty	Unit	Unit Price	Cost	Unit Price	Labor Cost	Total Cost
Collection System							
8-inch D-3034/SDR35 Gasketed PVC Sewer Pipe							
Up to 8 feet	25,909	LF	$ 3.00	$ 77,727.00	$ 48.30	$ 1,251,404.70	$ 1,329,131.70
8.1-10.0 feet	25,193	LF	$ 3.00	$ 75,579.00	$ 54.00	$ 1,360,422.00	$ 1,436,001.00
10.1 - 12.0 feet	6,038	LF	$ 3.00	$ 18,114.00	$ 70.15	$ 423,565.70	$ 441,879.70
12.1 - 14.0 feet	2,376	LF	$ 3.00	$ 7,128.00	$ 83.40	$ 198,158.40	$ 205,286.40
14.1 - 16.0 feet	663	LF	$ 3.00	$ 1,989.00	$ 99.00	$ 65,837.00	$ 67,826.00
16.1 - 18.0 feet	711	LF	$ 3.00	$ 2,133.00	$ 115.00	$ 81,765.00	$ 83,898.00
8" Outfall - D-3034/SDR35 Gasketed PVC Sewer Pipe							
Up to 8 feet	46,495	LF	$ 3.00	$ 139,485.00	$ 40.00	$ 1,859,800.00	$ 1,999,285.00
Subtotal 8-inch Gravity Sewer							**$ 5,562,907.60**
10-inch D-3034/SDR35 Gasketed PVC Sewer Pipe							$ -
Up to 8 feet	163	LF	$ 5.00	$ 815.00	$ 59.00	$ 9,617.00	$ 10,432.00
Subtotal 10-inch Gravity Sewer							**$ 10,432.00**
4-ft dia Sanitary Manhole							
Up to 8 feet	248	EA	$ 2,645.00	$ 655,960.00	$ -	$ -	$ 655,960.00
8.1-10.0 feet	214	EA	$ 3,095.00	$ 662,330.00	$ -	$ -	$ 662,330.00
10.1 - 12.0 feet	30	EA	$ 3,395.00	$ 101,850.00	$ -	$ -	$ 101,850.00
12.1 - 14.0 feet	14	EA	$ 3,480.00	$ 48,720.00	$ -	$ -	$ 48,720.00
14.1 - 16.0 feet	8	EA	$ 4,025.00	$ 32,200.00	$ -	$ -	$ 32,200.00
16.1 - 18.0 feet	4	EA	$ 4,390.00	$ 17,560.00	$ -	$ -	$ 17,560.00
18.1 - 20.0 feet	1	EA	$ 5,520.00	$ 5,520.00	$ -	$ -	$ 5,520.00
Outfall Manholes							
Up to 8 feet	226	EA	$ 2,245.00	$ 507,370.00	$ -		$ 507,370.00
Subtotal 4-ft dia. Manholes							**$ 2,031,510.00**
4" PVC Sewer Service Laterals							
Under Pavement	955	EA	$ 1,150.00	$1,098,250.00	$ -	$ -	$ 1,098,250.00
In Easement	410	EA	$ 575.00	$235,750.00	$ -	$ -	$ 235,750.00
Subtotal 4" PVC Sewer Laterals							**$ 1,334,000.00**
Miscellaneous Construction							
Cleaning, Inspecting, and Testing Sewers	107,400	LF	$ -	$0.00	$ 0.12	$ 12,888.00	$ 12,888.00
Remove and Replace Unsuitable Backfill Material	-	EA	$ 17.00	$0.00		$ -	$ -
(See Note 4 for Unsuitable Backfill)							
Maintenance of Traffic	1	LS	$ 575,000.00	$575,000.00	$ -	$ -	$575,000.00
Subtotal Miscellaneous Construction							**$ 587,888.00**
Restoration							
Asphalt Leveling & Overlay	135,673	SY	$ 12.45	$1,689,128.85	$ -	$ -	$ 1,689,128.85
Miscellaneous Restoration	1	LS	$ 2,000,000.00	$2,000,000.00	$ -	$ -	$ 2,000,000.00
Right-of-Way Restoration	42,000	SY	$ 6.50	$273,000.00	$ -	$ -	$ 273,000.00
Driveway Restoration	600	EA	$ 150.00	$90,000.00	$ -	$ -	$ 90,000.00
Subtotal Restoration							**$ 4,052,128.85**
Subtotal Gravity Collection System							**$ 13,578,866.66**
Contingency- Collection System (20%)							**$ 2,715,773.33**
Total Collection System							**$ 16,294,639.98**
Transmission System							
10" C-900 PVC FM	6,000	FT	$ 8.70	$52,200.00	$ 14.82	$ 88,920.00	$ 141,120.00
16" C-905 PVC FM	9,000	FT	$ 21.50	$193,500.00	$ 22.50	$ 202,500.00	$ 396,000.00
Submersible Pump Station	3	EA	$ 85,000.00	$255,000.00	$ -	$ -	$ 255,000.00
Subtotal Transmission System							**$ 792,120.00**
Contingency - Transmission System (10%)							**$ 79,212.00**
Total Transmission System							**$ 871,332.00**
Subtotal Collection & Transmission System Cost							$ 17,165,971.98
Mobilization, Bonds, and Insurance (10%)							**$ 1,716,597.20**
Engineering (7.5%)							**$ 1,287,447.90**
Construction Administration and Observation (6%)							**$ 1,029,958.32**
Public Information Program (1.5%)							**$ 257,489.58**
Total Collection/Transmission System Cost							$ 21,457,464.98
On-Lot Homeowners Cost							
Sewer Service Connection							
Septic Tank Demolition	1,166	EA	$ -	$0.00	$ 450.00	$ 524,700.00	$ 524,700.00
Service Laterals to Right of Way	1,166	EA	$ -		$ 500.00	$ 583,000.00	$ 583,000.00
Subtotal Sewer Service Connection							**$ 1,107,700.00**
Utility Service Provider Fees							
Utility Connection Fee	1,365	EA	$ 520.00	$709,800.00	$ -	$ -	$ 709,800.00
Utility System Fee	1,365	EA	$ 3,650.00	$4,982,250.00	$ -	$ -	$ 4,982,250.00
Subtotal Utility Service Provider Fees							**$ 5,692,050.00**
Total On-Lot Homeowner Costs							**$ 6,799,750.00**
TOTAL PROJECT COST							$ 28,257,214.98
Total Homeowner cost for a Developed Lot	1	EA	$ 4,170.00	$ 4,170.00	$ 950.00	$ 950.00	**$ 5,120.00**
Total Homeowner Cost for a Vacant Lot	1	EA	$ 4,170.00	$ 4,170.00	$ 500.00	$ 500.00	**$ 4,670.00**

Notes
1. All valves are assumed to be cast iron and/or bronze body with bronze gates
2. Opposite side service laterals are assumed to be jetted or drilled beneath road. Number of opposite side service laterals is estimated, actual number will be determined during design
3. Collection system restoration area calculations assume that 100% is asphalt, and an additional 25% for green areas.
4. Removal and Replacement of Unsuitable Backfill Material is included in SDR35 Gasketed PVC Sewer Pipe Labor Costs
Transmission system construction assumed to be open cut.
5. Septic Tank demolition prices ranged from $150 per unit (1000 unit minimum) excluding backfill material to $400 per unit (all units) - neither case is likely - used $450 per unit on request of contractor
6. Utility Fees quoted from City of Tallahassee ($450 Connection - $3,465 System Fee) and Talquin Electric Coop ($520 Connection - $3,650 system fee)
7. Homeowner costs for a single lot does not include collection and transmission costs.

Killearn Lakes Units 1 & 2 Municipal Sewer System Evaluation
Vacuum Sewer Option
Open-Cut Construction
SDR21 Gasketed PVC Sewer Pipe

Description	Qty	Unit	Materials		Labor		Total Cost
			Unit Price	Materials Cost	Unit Price	Labor Cost	
Collection System							
SDR21 Gasketed PVC Sewer Pipe							
4"	77,740	FT	$ 18.00	$ 1,399,320.00	$ -	$ -	$ 1,399,320.00
6"	26,390	FT	$ 22.00	$ 580,580.00	$ -	$ -	$ 580,580.00
8"	3,570	FT	$ 25.00	$ 89,250.00	$ -	$ -	$ 89,250.00
10"	800	FT	$ 29.00	$ 23,200.00	$ -	$ -	$ 23,200.00
Subtotal PVC Pipe							$ 2,092,360.00
Sewer Valves							
4"	115	EA	$ 800.00	$92,000.00			$ 92,000.00
6"	32	EA	$ 1,000.00	$32,000.00			$ 32,000.00
8"	4	EA	$ 1,250.00	$5,000.00			$ 5,000.00
Subtotal Sewer Valves							$ 129,000.00
Miscellaneous Construction							
Cleaning, Inspecting, and Testing Sewers	108,500	LF	$ -	$0.00	$0.08	$ 8,680.00	$ 8,680.00
Remove and Replace Unsuitable Backfill Material	23,000	CY	$ 17.00	$391,000.00			$ 391,000.00
Maintenance of Traffic	1		$ 400,000.00	$400,000.00			$ 400,000.00
Subtotal Miscellaneous Construction							$ 799,680.00
Service Laterals							
Same Side	685	EA	$ 250.00	$171,250.00			$ 171,250.00
Opposite Side	680	EA	$ 500.00	$340,000.00			$ 340,000.00
Subtotal Service Laterals							$ 511,250.00
Vacuum Equipment							
AIRVAC Valve Pits	784	EA	$ 3,200.00	$2,508,800.00			$ 2,508,800.00
Single Buffer Tanks	2	EA	$ 3,500.00	$7,000.00			$ 7,000.00
Special Tools	1	EA	$ 3,000.00	$3,000.00			$ 3,000.00
Portable Vacuum Pump (Testing)	1	EA	$ 16,500.00	$16,500.00			$ 16,500.00
Vacuum Stations Installation (for 3 stations)	1	LS	$ 1,016,200.00	$1,016,200.00			$ 1,016,200.00
Subtotal Vacuum Equipment							$ 2,526,250.00
Restoration							
Roadway Restoration	47,500	SY	$ 27.50	$1,306,250.00		$ -	$ 1,306,250.00
Miscellaneous Restoration	1	LS	$ 1,000,000.00	$1,000,000.00		$ -	$ 1,000,000.00
Right-of-Way Restoration	20,000	SY	$ 6.50	$130,000.00		$ -	$ 130,000.00
Driveway Restoration	600	EA	$ 150.00	$90,000.00		$ -	$ 90,000.00
Subtotal Restoration							$ 2,526,250.00
Subtotal Collection System							$ 8,584,780.00
Contingency- Collection System (20%)							$ 1,716,956.00
Total Collection System							$ 10,301,736.00
Transmission System							
10" C-900 PVC FM	6,000	FT	$ 8.70	$52,200.00	$ 14.82	$ 88,920.00	$ 141,120.00
16" C-905 PVC FM	9,000	FT	$ 21.50	$193,500.00	$ 22.50	$ 202,500.00	$ 396,000.00
Submersible Pump Station	-	EA	$ 85,000.00	$0.00	$ -	$ -	$ -
Subtotal Transmission System							$ 537,120.00
Contingency - Transmission System (10%)							$ 53,712.00
Total Transmission System							$ 590,832.00
Subtotal Collection & Transmission System Cost							$ 10,892,568.00
Mobilization, Bonds, and Insurance (10%)							$ 1,089,256.80
Engineering (7.5%)							$ 816,942.60
Construction Administration and Observation (6%)							$ 653,554.08
Public Information Program (1.5%)							$ 163,388.52
Total Collection/Transmission System Cost							$ 13,615,710.00
Private Homeowner Costs							
Septic Tank Demolition	1,166	EA	$ -	$0.00	$ 450.00	$ 524,700.00	$ 524,700.00
Service Laterals to Right of Way	1,166	EA	$ -		$ 500.00	$ 583,000.00	$ 583,000.00
Subtotal Private Homeowner Costs							$ 1,107,700.00
Utility Service Provider Fees							
Utility Connection Fee	1,365	EA	$ 520.00	$709,800.00	$ -	$ -	$ 709,800.00
Utility System Fee	1,365	EA	$ 3,650.00	$4,982,250.00	$ -	$ -	$ 4,982,250.00
Subtotal Utility Service Provider Fees							$ 5,692,050.00
Total On-Lot Homeowner Costs							$ 6,799,750.00
TOTAL PROJECT COST							$ 20,415,460.00
Total Homeowner cost for a Developed Lot	1	EA	$ 4,170.00	$ 4,170.00	$ 950.00	$ 950.00	$ 5,120.00
Total Homeowner Cost for a Vacant Lot	1	EA	$ 4,170.00	$ 4,170.00	$ 500.00	$ 500.00	$ 4,670.00

Notes:

1. All valves are assumed to be cast iron and/or bronze body with bronze gates.
2. Opposite side service laterals are assumed to be jetted or drilled beneath road. Number of opposite side service laterals is estimated, actual number will be determined during
3. Collection system restoration area calculations assume that 70% is in unpaved R/W, 25% in asphalt, and 5% Driveways
4. Remove and Replace Unsuitable Backfill Material Line item assumes that all excavated material is unsuitable for backfill.
5. Transmission system construction assumed to be open cut.
6. Septic Tank demolition prices ranged from $150 per unit (1000 unit minimum) excluding backfill material to $400 per unit (all units) - neither case is likely - used $450 per unit on
7. Utility Fees quoted from City of Tallahassee ($450 Connection - $3,466 System Fee) and Talquin Electric Coop. ($520 Connection - $3,650 system fee).
8. Homeowner costs for a single lot does not include collection and transmission costs.

ATTACHMENT # 1
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Killearn Lakes Units 1 & 2 Municipal Sewer System Evaluation
Low Pressure Sewer Option
Horizontal Directional Drilling Construction
DR11 HDPE - Fusion Welded Pipe

			Materials		Labor		
Description	Qty	Unit	Unit Price	Materials Cost	Unit Price	Labor Cost	Total Cost
Collection System							
DR11 HDPE Pipe - Including Fittings							
1.5"	1,695	FT	$ 0.85	$ 1,440.75	$ 11.00	$ 18,645.00	$ 20,085.75
2"	30,430	FT	$ 0.95	$ 28,908.50	$ 11.00	$ 334,730.00	$ 363,638.50
3"	21,295	FT	$ 1.45	$ 30,877.75	$ 12.00	$ 255,540.00	$ 286,417.75
4"	19,435	FT	$ 2.25	$ 43,728.75	$ 14.00	$ 272,090.00	$ 315,818.75
6"	2,540	FT	$ 4.40	$ 11,176.00	$ 20.00	$ 50,800.00	$ 61,976.00
Subtotal HDPE Pipe & Fittings							$ 1,047,936.75
Sewer Valves							
1.5"	1	EA	$ 100.00	$100.00			$ 100.00
2"	27	EA	$ 150.00	$4,050.00			$ 4,050.00
3"	29	EA	$ 300.00	$8,700.00			$ 8,700.00
4"	14	EA	$ 525.00	$7,350.00			$ 7,350.00
6"	2	EA	$ 700.00	$1,400.00			$ 1,400.00
Subtotal Sewer Valves							$ 21,600.00
Miscellaneous Construction							
Cleaning, Inspecting, and Testing Sewers	75,500	LF	$ -	$0.00	$0.08	$ 6,040.00	$ 6,040.00
Remove and Replace Unsuitable Backfill Material	2,500	CY	$ 14.00	$35,000.00			$ 35,000.00
Maintenance of Traffic	1		$ 100,000.00	$100,000.00			$ 100,000.00
Subtotal Miscellaneous Construction							$ 41,040.00
Service Laterals							
Same Side	685	LF	$ 250.00	$171,250.00			$ 171,250.00
Opposite Side	680	LF	$ 500.00	$340,000.00			$ 340,000.00
2" Valve Assembly	1,365	EA	$ 250.00	$341,250.00			$ 341,250.00
Subtotal Service laterals							$ 852,500.00
Restoration							
Roadway Restoration	2,000	SY	$ 27.50	$55,000.00		$ -	$ 55,000.00
Right-of-Way Restoration	4,000	SY	$ 6.50	$26,000.00		$ -	$ 26,000.00
Driveway Restoration	100	EA	$ 150.00	$15,000.00		$ -	$ 15,000.00
Subtotal Restoration							$ 96,000.00
Subtotal Collection System							$ 2,059,076.75
Contingency- Collection System (20%)							$ 411,815.35
Total Collection System							$ 2,470,892.10
Transmission System							
10" DR11 HDPE FM	6,000	FT	$ 10.50	$63,000.00	$ 12.60	$ 75,600.00	$138,600.00
16" DR11 HDPE FM	9,000	FT	$ 23.50	$211,500.00	$ 17.80	$ 160,200.00	$ 371,700.00
Submersible Pump Station	3	EA	$ 85,000.00	$255,000.00	$ -	$ -	$ 255,000.00
Subtotal Transmission System							$ 765,300.00
Contingency - Transmission System (10%)							$ 76,530.00
Total Transmission System							$ 841,830.00
Subtotal Collection & Transmission System Cost							$ 3,312,722.10
Mobilization, Bonds, and Insurance (10%)							$ 331,272.21
Engineering (7.5%)							$ 248,454.16
Construction Administration and Observation (6%)							$ 198,763.33
Public Information Program (1.5%)							$ 49,690.83
Total Collection/Transmission System Cost							$ 4,140,902.63
Private Homeowner Costs							
Grinder Pump Stations	1,365	EA	$ 2,500.00	$3,412,500.00	$ 1,500.00	$ 2,047,500.00	$ 5,460,000.00
Septic Tank Demolition	1,166	EA	$ -	$0.00	$ 450.00	$ 524,700.00	$ 524,700.00
Subtotal Private Homeowner Costs							$ 5,984,700.00
Utility Service Provider Fees							
Utility Connection Fee	1,365	EA	$ 520.00	$709,800.00	$ -	$ -	$ 709,800.00
Utility System Fee	1,365	EA	$ 3,650.00	$4,982,250.00	$ -	$ -	$ 4,982,250.00
Subtotal Utility Service Provider Fees							$ 5,692,050.00
Total On-Lot Homeowner Costs							$ 11,676,750.00
TOTAL PROJECT COST							$ 15,317,652.63
Total Homeowner cost for a Developed Lot	1	EA	$ 6,670.00	$ 6,670.00	$ 1,950.00	$ 1,950.00	$ 8,620.00
Total Homeowner Cost for a Vacant Lot	1	EA	$ 6,670.00	$ 6,670.00	$ 1,500.00	$ 1,500.00	$ 8,170.00

Notes:
1. HDPE Pipe includes allowance for fittings: $0.40 pe LF for 1.5-inch through 3-inch pipe; $0.50 per LF for 4-inch pipe; and $0.60 per LF for 6-inch pipe.
2. All valves are assumed to be cast iron and/or bronze body with bronze gates.
3. Opposite side service laterals are assumed to be jetted or drilled beneath road. Number of opposite side service laterals is estimated, actual number will be determined during
4. Restoration figures for HDD process are estimated. Number of excavations is unknown at this time.
5. 2" Valve Assembly includes 2" check valve and 2" ball valve (capped) - all enclosed within a plastic valve box located at the right-of-way/property line.
6. Transmission system construction assumed to be open cut.
7. Grinder Pump Station Costs - Four quote received ranging from $2,010 to $3,290. This does not include quantity discount. Average value of four quotes is $2,500 and is used in
8. Septic Tank demolition prices ranged from $150 per unit (1000 unit minimum) excluding backfill material to $400 per runit (all units) - neither case is likely - used $450 per unit on
9. Utility Fees quoted from City of Tallahassee ($450 Connection - $3,465 System Fee) and Talquin Electric Coop. ($520 Connection - $3,650 system fee).
10. Homeowner costs for a single lot does not include collection and transmission costs.

Killearn Lakes Units 1 & 2 Municipal Sewer System Evaluation
Low Pressure Sewer Option
Open-Cut Construction
SDR21 PVC - Gasketed Pipe

			Materials		Labor		
Description	Qty	Unit	Unit Price	Materials Cost	Unit Price	Labor Cost	Total Cost
Collection System							
SDR21 Gasketed PVC - Including Fittings							
1.5"	1,696	FT	$ 0.85	$ 1,440.75	$ 5.94	$ 10,068.30	$ 11,509.05
2"	30,430	FT	$ 0.85	$ 25,865.50	$ 5.94	$ 180,754.20	$ 206,619.70
3"	21,295	FT	$ 1.25	$ 26,618.75	$ 6.10	$ 129,899.50	$ 156,518.25
4"	19,435	FT	$ 1.90	$ 36,926.50	$ 6.36	$ 123,606.60	$ 160,533.10
6"	2,540	FT	$ 3.60	$ 9,144.00	$ 7.04	$ 17,881.60	$ 27,025.60
Subtotal PVC Pipe and Fittings							$ 562,205.70
Sewer Valves							
1.5"	1	EA	$ 100.00	$100.00			$ 100.00
2"	27	EA	$ 150.00	$4,050.00			$ 4,050.00
3"	29	EA	$ 300.00	$8,700.00			$ 8,700.00
4"	14	EA	$ 525.00	$7,350.00			$ 7,350.00
6"	2	EA	$ 700.00	$1,400.00			$ 1,400.00
Subtotal Sewer Valves							$ 21,600.00
Miscellaneous Construction							
Cleaning, Inspecting, and Testing Sewers	75,500	LF	$ -	$0.00	$0.08	$ 6,040.00	$ 6,040.00
Remove and Replace Unsuitable Backfill Material	23,000	CY	$ 14.00	$322,000.00			$ 322,000.00
Maintenance of Traffic	1		$ 250,000.00	$250,000.00			$ 250,000.00
Subtotal Miscellaneous Construction							$ 328,040.00
Service Laterals							
Same Side	685	LF	$ 250.00	$171,250.00			$ 171,250.00
Opposite Side	680	LF	$ 500.00	$340,000.00			$ 340,000.00
2" Valve Assembly	1,365	EA	$ 250.00	$341,250.00			$ 341,250.00
Subtotal Service Laterals							$ 852,500.00
Restoration							
Roadway Restoration	8,200	SY	$ 27.50	$225,500.00		$ -	$ 225,500.00
Miscellaneous Restoration	1	LS	$ 250,000.00	$250,000.00		$ -	$ 250,000.00
Right-of-Way Restoration	22,750	SY	$ 6.50	$147,875.00		$ -	$ 147,875.00
Driveway Restoration	600	EA	$ 150.00	$90,000.00		$ -	$ 90,000.00
Subtotal restoration							$ 713,375.00
Subtotal Collection System							$ 2,477,720.70
Contingency- Collection System (20%)							$ 495,544.14
Total Collection System							$ 2,973,264.84
Transmission System							
10" C-900 PVC FM	6,000	FT	$ 8.70	$52,200.00	$ 14.82	$ 88,920.00	$ 141,120.00
16" C-905 PVC FM	9,000	FT	$ 21.50	$193,500.00	$ 22.50	$ 202,500.00	$ 396,000.00
Submersible Pump Station	3	EA	$ 85,000.00	$255,000.00	$ -	$ -	$ 255,000.00
Subtotal Transmission System							$ 792,120.00
Contingency - Transmission System (10%)							$ 79,212.00
Total Transmission System							$ 871,332.00
Subtotal Collection & Transmission System Cost							$ 3,844,596.84
Mobilization, Bonds, and Insurance (10%)							$ 384,459.68
Engineering (7.5%)							$ 288,344.76
Construction Administration and Observation (6%)							$ 230,675.81
Public Information Program (1.5%)							$ 57,668.95
Total Collection/Transmission System Cost							$ 4,805,746.05
Private Homeowner Costs							
Grinder Pump Stations	1,365	EA	$ 2,500.00	$3,412,500.00	$ 1,500.00	$ 2,047,500.00	$ 5,460,000.00
Septic Tank Demolition	1,166	EA	$ -	$0.00	$ 450.00	$ 524,700.00	$ 524,700.00
Subtotal Private Homeowner Costs							$ 5,984,700.00
Utility Service Provider Fees							
Utility Connection Fee	1,365	EA	$ 520.00	$709,800.00	$ -	$ -	$ 709,800.00
Utility System Fee	1,365	EA	$ 3,650.00	$4,982,250.00	$ -	$ -	$ 4,982,250.00
Subtotal Utility Service Provider Fees							$ 5,692,050.00
Total On-Lot Homeowner Costs							$ 11,676,750.00
TOTAL PROJECT COST							$ 16,482,496.05
Developed Lot - Total Homeowner Cost	1	EA	$ 6,670.00	$ 6,670.00	$ 1,950.00	$ 1,950.00	$ 8,620.00
Vacant Lot - Total Homeowner Cost	1	EA	$ 6,670.00	$ 6,670.00	$ 1,500.00	$ 1,500.00	$ 8,170.00

Notes:

1. SDR21 Gasketed PVC Pipe includes allowance for fittings: $0.40 pe LF for 1.5-inch through 3-inch; $0.50 per LF for 4-inch pipe; and $0.60 per LF for 6-inch pipe.
2. All valves are assumed to be cast iron and/or bronze body with bronze gates.
3. Opposite side service laterals are assumed to be jetted or drilled beneath road. Number of opposite side service laterals is estimated, actual number will be determined during
4. Collection system restoration area calculations assume that 70% is in unpaved R/W, 25% in asphalt, and 5% Driveways
5. 2" Valve Assembly includes 2" check valve and 2" ball valve (capped) - all enclosed within a plastic valve box located at the right-of-way/property line.
6. Remove and Replace Unsuitable Backfill Material Line Item assumes that all excavated material is unsuitable for backfill.
7. Transmission system construction assumed to be open cut.
8. Grinder Pump Station Costs - Four quote received ranging from $2,010 to $3,290. This does not include quantity discount. Average value of four quotes is $2,500 and is used in
9. Septic Tank demolition prices ranged from $150 per unit (1000 unit minimum) excluding backfill material to $400 per runit (all units) - neither case is likely - used $450 per unit on
10. Utility Fees quoted from City of Tallahassee ($450 Connection - $3,465 System Fee) and Talquin Electric Coop. ($520 Connection - 3,650 system fee).
11. Homeowner costs for a single lot does not include collection and transmition costs.

Appendix - B
Operation and Maintenance Cost Estimates

Gravity System O&M Cost Estimate

Known Elements

Number of Pump Stations	**1**	stations
Number of Service Connections	**1365**	

Equipment Cost						
Pump Station		Replacement Cost	Useful Life (Years)	Quantity		Annual Replacement Cost
Sewage Pumps	$	6,200	15	3	$	1,240
Control Panel	$	10,000	20	1	$	500
Miscellaneous Equipment	$	2,000	15	1	$	133
Subtotal Equipment Cost					**$**	**1,873**

Piping Cost		Unit Price	Length of Pipe		Annual Pipe O&M Cost
Annual cost per foot of pipe (@ $0.12 per LF every 5 yrs.)	$	0.15	60,000	**$**	**1,800**

Power Cost					
Pump Station Station		Power Cost			Annual Power Cost
Flat Rate	$	50	per month per station	$	600
Consumption	$	1.75	per month per connection	$	28,665
Subtotal Power Cost				**$**	**29,265**

Total Annual O&M Cost		
Equipment	$	1,873
Piping	$	1,800
Power	$	29,265
Total O&M Cost	**$**	**32,938**
Total O&M Cost per Connection	**$**	**24.13**

Vacuum System O&M Cost Estimate

Known Elements

Number of Vacuum Stations	**3**	stations
Number of Connections	**1365**	(also equals number of valve pits)

Equipment Cost

Vacuum Station	Replacement Cost	Useful Life (Years)	Quantity	Annual Replacement Cost
Vacuum Pumps	$ 15,800	15	6	$ 6,320
Sewage Pumps	$ 6,200	15	6	$ 2,480
Collection Tanks	$ 7,450	15	3	$ 1,490
Control Panel	$ 10,000	20	3	$ 1,500
Miscellaneous Equipment	$ 2,000	15	3	$ 400
Vacuum Valves	$ 20	10	786	$ 1,572
Controller	$ 40	7	786	$ 4,491
Miscellaneous Equipment	$ 20	10	786	$ 1,572
Subtotal Equipment Cost				**$ 19,825**

Labor Cost

	Labor Cost	Labor Effort		Annual Labor Cost
Vacuum Station	$ 15.00	300	hr/yr/station	$ 13,500
Piping	$ 15.00	60	hr/yr/station	$ 2,700
Valves	$ 15.00	1.75	hr/yr/valve	$ 35,831
Subtotal Labor Cost				**$ 52,031**

Piping Cost

	Unit Price	Length of Pipe	Annual Pipe O&M Cost
Annual cost per foot of pipe (@ $0.10 per LF every 5 yrs.)	$ 0.10	60,000	**$ 1,200**

Power Cost

Vacuum Station	Power Cost		Annual Power Cost
Flat Rate	$ 50	per month per station	$ 1,800
Consumption	$ 1.75	per month per connection	$ 28,665
Subtotal Power Cost			**$ 30,465**

Total Annual O&M Cost

Piping	$ 1,200
Equipment	$ 19,825
Labor	$ 52,031
Power	$ 30,465
Total O&M Cost	**$ 103,522**
Total O&M Cost per Connection	**$ 75.84**

Low-Pressure System O&M Cost Estimate

Known Elements

Length of Pipe	60,000	LF
Number of Master Pump Stations	3	stations
Number of Grinder Pump Stations in System	1365	stations
Inflow Into Grinder Station	200	GPD
Grinder Pump Flow Rate	17.5	GPM
Grinder Pump Voltage	230	Volts
Grinder Pump Amp Draw at Flow Rate	12	Amps
Grinder Station Control Circuit Voltage	115	Volts
Grinder Station Control Circuit Amp Draw	0.054	Amps
Cost of Power	$ 0.08	$ / kWh

Power Calculations / Unit

Pump	2,760.00	Watts	2.76	kW
Control	6.21	Watts	0.00621	kW
Total	2,766.21	Watts	2.76621	kW

Run-Time Calculations

Avg. Minutes Per Day of Operation	11.43	min/day
Convert to Hours Per Day	0.19	hr/day
Convert to Hours per Year	69.52	hr/yr

Energy Use Calculations

Energy Use per Day	526.90	Watts	0.53	kW
Projected Energy Use per Year	192,317.46	Watts	192.32	kW

Energy Cost Calculations

Daily Energy Cost	$ 0.04	per station
Annual Energy Cost	$ 15.87	per station
System Daily Energy Cost	$ 59.34	
System Annual Energy Cost	$ 21,657.35	

Piping Cost

	Unit Price	Length of Pipe	Annual Pipe O&M Cost
Annual cost per foot of pipe (@ $0.15 per LF every 5 yrs.)	$ 0.15	60,000	$ 1,800.00

Grinder Station Maintenance Cost Calculations

* Annual Avg. Grinder Station Maint. Cost	$ 35.00	per station
System Annual Avg. Grinder Station Maint. Cost	$ 47,775.00	

Master Pump Station Equipment Cost

Master Pump Station	Replacement Cost	Useful Life (Years)	Quantity	Annual Replacement Cost
Sewage Pumps	$ 6,200	15	6	$ 2,480
Control Panel	$ 10,000	20	3	$ 1,500
Miscellaneous Equipment	$ 2,000	15	3	$ 400
SubtotalEquipment Cost				$ 4,380

Master PS Power Cost

Pump Station Station	Power Cost		Annual Power Cost
Flat Rate	$ 50	per month per station	$ 1,800
Consumption	$ 1.75	per month per connection	$ 28,665
Subtotal Power Cost			$ 30,465

Total O&M Cost

Total System Annual Average O&M Cost	**$ 106,077.35**	
Total Annual Average O&M Cost per Unit	**$ 77.71**	per Unit

* Per E-One case study "Low Pressure Sewers - The Economic Advantages"

Assumptions
- Amp draw of Control Circuit does not include operation of alarm circuit because it is not part of normal operatiing conditions.
- Runtime-time calculations average anticipated inflow into pump station and avg anticiapted pump flow rate.